

**Saint Leo University**  
**School of Arts and Sciences**  
**Evaluating the Predictions of Global Warming**

**COURSE DESCRIPTION:**

This course presents the science behind the mechanisms that effect global climate change to enable critical analysis of the potential severity of rapid climate change on the atmosphere, the oceans and the biosphere. It includes an overview of chemistry, physics, ecology, the carbon cycle, solar system science, and how these tools will allow critical analysis of climate model forecasts and the effects of greenhouse gasses.

**Prerequisites:**

MAT 003 or placement in MAT 128 or higher

**TEXT:**

Required: Energy, Environment, and Climate, 3<sup>rd</sup> edition 2018, Richard Wolfson, W. W. Norton & Company, New York, NY ISBN 9780393622911

**LEARNING OUTCOMES:**

Upon completion of the course, you will be able to:

1. Evaluate scientific theories using scientific principles, *analyzing predictions of Global Climate Change by employing the scientific method through Module Exams & Quizzes, Homework, Scientific Research Paper and Cumulative Final Exam. SC3*
2. Support decisions using rigorous arguments based on criteria and *evidence such as applying integrated physical science principles, including the nature of matter and energy, elementary chemistry, thermal energy and heat transfer theory through Module Exams & Quizzes, Homework, Scientific Research Paper and Cumulative Final Exam. CT3*
3. Explain Earth's Great Cycles, the carbon cycle, and the difference between climate and weather through *Module Exams & Quizzes, Homework, Scientific Research Paper and Cumulative Final Exam.*
4. Summarize thermal energy and heat transfer theory, the nature of the sun and its relationship to the solar system, the Greenhouse Effect, and their effects on global climate through *Module Exams & Quizzes, Homework, Scientific Research Paper and Cumulative Final Exam.*
5. Describe the impact of human decisions on environment systems *addressing the world's energy needs and energy sources, and compare and contrast fossil fuels to alternative energy sources through Module Exams & Quizzes, Homework, Scientific Research Paper and Cumulative Final Exam. SC2*
6. The Core Value emphasized in this course will be **Responsible Stewardship**. Students will learn to optimize the uses of natural resources, to maximize performance and minimize costs, while assuring safety of the environment and the prosperity of the global community through *Module Exams & Quizzes, Homework, Scientific Research Paper and Cumulative Final Exam and Additional Credit Opportunities.*

**Core Values**

The core value emphasized in this course will be **Responsible Stewardship**, as students learn the importance of managing the world's natural resources.

**Evaluation:**

<b>Item</b>	<b>Points</b>	<b>Weight</b>
A. Exams (2)	100	20%
B. Module Quizzes (5)	12	10%
C. Homework/Discussion (8)	100	15%
D. Research Paper	100	25%
E. Cumulative Final Exam	100	30%
<hr/> Total	<hr/> <b>1260</b>	<hr/> <b>100%</b>

**Module Exams:**

There will be 2 exams within the term, each covering half the course material. The first will assess the outcomes of the first 4 modules and the second will cover the remaining modules. These exams should be a mixture of short answer, definition, true/false, and problem solving, and will be approximately 1 hour in duration for the mid-term exam, and 2 hours in duration for the final exam. (Learning Outcomes 1-6)

**Module Quizzes:**

Each module that does not have an exam should include a quiz, approximately 25 minutes in length, assessing the learning outcomes of that module. (Learning Outcomes 1-6)

**Homework:**

Homework should provide practice problems and questions to help students master the learning outcomes from that module. (Learning Outcomes 1-6)

**The Scientific Research Paper:**

Must include peer reviewed citations for all relevant facts, and the topic of the paper must directly pertain to learning objectives included in the first 4 modules, and how they pertain to Global Warming theory. (Learning Outcomes 1-6)

**A Cumulative Final Exam:**

Required and to be scheduled during Final Exam week, and should cover material covered through the entire course. The final exam should include questions that assess synthesis of all material and how it pertains to Global Warming Theory, and will be comprised of the same type of questions found in the midterm exam, and should be approximately 2 hours in duration. (Learning Outcomes 1-6)

**Additional Credit Opportunities:**

Consideration may be given to additional credit under "other" for areas (for example classroom attendance) not to exceed 10 % of the grade for all of other assessments. (Learning Outcome 6)

**Grading Scale:**

<b>Grade</b>	<b>Percentage</b>
<b>A</b>	94% to 100%
<b>A-</b>	90% to 93%
<b>B+</b>	87% to 89%
<b>B</b>	84% to 86%
<b>B-</b>	80% to 83%
<b>C+</b>	77% to 79%

<b>C</b>	74% to 76%
<b>C-</b>	70% to 73%
<b>D+</b>	67% to 69%
<b>D</b>	60% to 66%
<b>F</b>	Below 60%

**SCHEDULE:**

**Module 1 Earth – from then until now**

**Objectives** When you complete this module, you should be able to:

- Describe Earth's origins, and the dynamic processes between energy and matter that have formed the modern world.
- Discuss the evolution of Earth's atmosphere and the processes that naturally balance carbon dioxide and climate.
- Examine the impact of human population on energy flows and fuel.
- Illustrate examples of energy and power in terms of global production and global consumption.

**Readings** Chapters 1 and 2

**Assignments**

<b>Items to be Completed:</b>	<b>Due No Later Than:</b>
Post an introduction to the class	Thursday 11:59 PM EST/EDT
Post an initial response to the discussion question	Thursday 11:59 PM EST/EDT
Post responses to at least one classmate	Sunday 11:59 PM EST/EDT
Complete <i>Module 1 Quiz</i>	Sunday 11:59 PM EST/EDT

**Module 2 PHYSICS - Heat and Temperature, Work and Energy, Heat Capacity, and the Second Law of Thermodynamics**

**Objectives** When you complete this module, you should be able to:

- Classify basic energy concepts, either kinetic, as motion, or potential energy associated with forces to illustrate that energy is stored as chemical or nuclear energy in fuels and as gravitational energy.
- Describe the relationship between energy and power and how to convert between power units.
- Distinguish between heat, temperature, and the relationship with energy to clarify the different temperature scales.
- Analyze the restrictions governed by the second law of thermodynamics in terms of efficiency and heat tax to identify methods of heat transfer, and why heat capacity is so important to the climate.

**Readings** Chapters 3 and 4

**Assignments**

Items to be Completed:	Due No Later Than:
Post an initial response to the discussion question	Thursday 11:59 PM EST/EDT
Post responses to at least one classmate	Sunday 11:59 PM EST/EDT
Complete <i>Module 2 Quiz</i>	Sunday 11:59 PM EST/EDT

### Module 3                      Fossil Fuels and their Environmental Impact

**Objectives**                      When you complete this module, you should be able to:

- Analyze the history of fossil fuels, extraction and refining, and the petroleum products that are produced, as well as carbon dioxide that results from using these fuels in power plants and internal combustion engines.
- Compare and contrast the environmental impacts of coal, oil and natural gas extraction, by conventional and non-conventional methods to assess the magnitude of the air pollution generated by the combustion of fossil fuels.
- Identify elementary chemical reactions related to the atmosphere, which illustrates the extent of the air pollution.
- Evaluate the policy issues, carbon tax schemes, and environmental legislation governing air quality and climate.

**Readings**                      Chapters 5 and 6

#### Assignments

Items to be Completed:	Due No Later Than:
Post an initial response to the discussion question	Thursday 11:59 PM EST/EDT
Post responses to at least one classmate	Sunday 11:59 PM EST/EDT
Complete <i>Exam 1</i>	Sunday 11:59 PM EST/EDT

### Module 4                      Nuclear, Geothermal, Tidal and Oceanic Energy – Alternative Sources

**Objectives**                      When you complete this module, you should be able to:

- Differentiate the structure of atoms, isotopes, and the nature of radioactivity and half-life of radioactive isotopes.
- Compare and contrast nuclear fission, nuclear fusion, nuclear power plant design and the effects of radiation and the associated environmental impacts of nuclear power generation.
- Discuss geothermal energy resources and technology for electric power generation, including the environmental impacts associated with geothermal heat.
- Examine the origins of tidal energy and methods of harnessing the energy, as well as the environmental impacts of the technology.

**Readings**                      Chapters 7 and 8

## Assignments

Items to be Completed:	Due No Later Than:
Post an initial response to the discussion question	Thursday 11:59 PM EST/EDT
Post responses to at least one classmate	Sunday 11:59 PM EST/EDT
Complete <i>Module 4 Quiz</i>	Sunday 11:59 PM EST/EDT

## Module 5                      Solar, Water, Wind and Biomass Energy – Alternative Sources

**Objectives**                      When you complete this module, you should be able to:

- Distinguish the enormous energy source that exists in solar radiation, the distribution of that energy and the technologies and limitations that currently exist with solar energy.
- Examine the history and use of hydropower (as an indirect form of solar), the technologies required to harness water power and the environmental impacts of hydroelectricity.
- Describe the history and use of wind as another form of indirect solar energy, by studying the prevailing global wind patterns coupled with wind turbine technology to distinguish the environmental impact of wind energy.
- Clarify biomass as a fuel source is the oldest external energy source that consists of recently living matter that is either directly burned or stored as energy, buried in landfills.

**Readings**                      Chapters 9 and 10

## Assignments

Items to be Completed:	Due No Later Than:
Post an initial response to the discussion question	Thursday 11:59 PM EST/EDT
Post responses to at least one classmate	Sunday 11:59 PM EST/EDT
Complete <i>Module 5 Quiz</i>	Sunday 11:59 PM EST/EDT

## Module 6                      Energy Carriers and the Science of Climate

**Objectives**                      When you complete this module, you should be able to:

- Differentiate the various sources of energy for electric power depending on geographical location to predict the simple electrical concepts and the quantitative relationships of electricity according to physics.
- Examine the modern grid, the difficulties of storing energy, and the move toward a hydrogen economy to confirm that closely related is the safety, and the impacts of a hydrogen economy.

- Correlate energy production, human energy use, and climate change by assessing the energy balance of the Earth, and the greenhouse effect.
- Illustrate the scientific method, and the difference between a theory, and a scientific theory, which is grounded in long established basic principles of physics and chemistry – reinforced by observations and data.

**Readings** Chapters 11 and 12

**Assignments**

Items to be Completed:	Due No Later Than:
Post an initial response to the discussion question	Thursday 11:59 PM EST/EDT
Post responses to at least one classmate	Sunday 11:59 PM EST/EDT
Complete <i>Exam 2</i>	Sunday 11:59 PM EST/EDT

**Module 7 Forcing the Climate; Natural and Anthropogenic**

**Objectives** When you complete this module, you should be able to:

- Distinguish forcing as an applied push or pull to a mechanical system and observing the response to translate the forcing to climate forcing and observe the response in the climate.
- Evaluate the greenhouse gases and the connection of carbon dioxide to global warming to correlate carbon, and the natural carbon cycle, as well as the anthropogenic perturbation to the cycle.
- Verify the global temperature records, both direct and by proxy measurements to construct the historical record of climate.
- Survey the glacial and interglacial periods through the Earth’s history; correlate the Earth’s Great Cycles (Milankovitch cycles) with the occurrence of the ice ages.

**Readings** Chapters 13 and 14

**Assignments**

Items to be Completed:	Due No Later Than:
Post an initial response to the discussion question	Thursday 11:59 PM EST/EDT
Post responses to at least one classmate	Sunday 11:59 PM EST/EDT
Submit <i>Global Warming Paper</i>	Sunday 11:59 PM EST/EDT
Complete <i>Exam 2</i>	Sunday 11:59 PM EST/EDT

**Module 8 Models, Predictions and Strategies: The Future Climate**

**Objectives**

When you complete this module, you should be able to:

- Propose future climate predictions by modeling, while considering the data and the model validity.
- Research the consequences of global climate change, including extreme weather events, a rise in the sea level, change in ecosystems and habitats, and change in ocean circulations and acidity.
- Judge the approaches to minimize anthropogenic climate change, including geoengineering, and carbon capture and storage.
- Confirm and appraise strategies for a sustainable future and global climate stabilization.

**Readings**

Chapters 15 and 16

**Assignments**

<b>Items to be Completed:</b>	<b>Due No Later Than:</b>
Post an initial response to the discussion question	Thursday 11:59 PM EST/EDT
Post responses to at least one classmate	Sunday 11:59 PM EST/EDT
Complete <i>Final Cumulative Exam</i>	Sunday 11:59 PM EST/EDT

**ATTENDANCE POLICY:** For an online course the attendance will be evaluated by the students' participation in the course.

**LATE WORK/MAKE UP POLICY:** Late work is not accepted, as this puts an undue burden on the instructor. If there are extenuating circumstances, they will be evaluated on a case-by-case basis.